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Two new genera of Encyrtidae (Hymenoptera, Chalcidoidea) with reduced ovipositor sheaths

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Abstract

Archaeocercoides puchkovi Simutnik, **gen. et sp.nov.,** and *Rovnopositor voblenkoi* Simutnik, **gen. et sp.nov.**, are described and illustrated based on female specimens from late Eocene Rovno amber. Like most previously described Eocene Encyrtidae, the new taxa differ from the majority of extant encyrtids by the apical or nearly apical position of the cerci, the short radicle, and the long marginal vein of the forewing. Both new genera are characterized by a strongly reduced ovipositor sheaths but long and upwardly bent ovipositor stylets (in the "ovipositing position"), a stigmal vein with a long uncus, and the absence of a filum spinosum. The new genera differ from each other in the width of frontovertex, the location of the cerci, and the lengths of funicular segments and marginal vein. *A. puchkovi* was fossilized near a Coccoidea crawler.

Keywords

Cerci, Coccoidea, radicle, Rovno amber, syninclusion, valvulae of ovipositor

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Introduction

An extremely apical or near apical position of the cerci is very rare among extant encyrtids, but is seen in most extinct ones (Simutnik and Perkovsky 2006, 2018a; Simutnik 2021; Simutnik et al. 2021a, 2021b). Two new fossil encyrtid genera with this character state are described below.

This brings the number of Rovno amber hymenopteran genera unknown in Baltic amber to 28 of 90, i.e., 31% (our unpublished data). This includes 22 of 52 (42.3%) non-ant hymenopterans genera and 46 of 69 of non-ant species (66.7%) (Perkovsky 2018; Manukyan 2019; Martynova et al. 2019; Perkovsky et al. 2020; Simutnik and Perkovsky 2020; Simutnik et al. 2020, 2021b; Belokobylskij et al. 2021; Colombo et al. 2021a, b, c; Manukyan and Zhindarev 2021). Baltic amber species from large arthropod orders and suborders reported from Rovno amber vary from 32.4% for Trichoptera (Perkovsky 2017; Melnitsky et al. 2021a, 2021b, 2021c), 24% for Nematocera (Giłka et al 2021) and 15% for Coleoptera (Telnov et al. 2021; Kirichenko-Babko et al. 2022; Perkovsky et al. 2022); 33% of non-ant hymenopterans common for Baltic and Rovno amber is close to the ratio for caddisflies (Trichoptera), which have been extensively studied (e.g., Melnitsky et al. 2021c and references therein). As more than 300 insect species have been described from Rovno amber (Martynov et al. 2021), this supports an independent origin of its fauna.

Material and methods

The studied specimens are housed in the collection of the Schmalhausen Institute of Zoology of the National Academy of Sciences of Ukraine, Kiev (SIZK). The amber pieces containing the holotypes were found in the Varash District of Rovno Region (UA-28099) (Yamamoto et al. 2022 and references therein), and in Pugach quarry (Klesov) (fauna of the deposit reviewed in Mitov et al. 2021), Sarny District, Rovno Region (K-9948). The Varash specimen was cut from the big piece, the Klesov specimen is part of an unbiased sample (Perkovsky et al. 2012), bought from the Ukramber factory (Rovno); the raw weight of clear piece 2-1410 was 7.3 g, size 45×25×15 mm.

Photographs were taken using a Leica Z16 APO stereomicroscope equipped with a Leica DFC 450 camera and processed with LAS Core and Adobe Photoshop software (brightness and contrast only). To improve imaging, we applied sucrose syrup of approximately the same refractive index as the amber itself and then placed a glass cover slip on top. To photograph some of the structures, the cover slip was placed at different angles to the surface of the amber (Fig. 1A). Afterwards, the syrup was removed by warm water.

Terminology and abbreviations follow Sharkov (1985), Gibson (1997), and Heraty et al. (2013). The following abbreviations are used in the text: **F1, F2, etc.** = funicular segments 1, 2, etc.; **LOL** = minimum distance between the anterior ocellus and a

posterior ocellus; **Mt1, Mt2, etc.** = metasomal terga, numbering starts from petiole (Mt1); **OOL** = minimum distance between an eye margin and the adjacent posterior ocellus; **OCL** = minimum distance between a posterior ocellus and the occipital margin; **POL** = minimum distance between the posterior ocelli.

Results

Systematic paleontology

Chalcidoidea Latreille, 1817
Encyrtidae Walker, 1837

Genus *Archaeocercoides* Simutnik, gen. nov.
http://zoobank.org/DAE286E2-09CB-438D-A5B7-F467697167DB

Type species. *Archaeocercoides puchkovi* Simutnik, sp. nov.

Species composition. Type species only.

Etymology. The new genus resembles the extinct genus *Archaeocercus* Simutnik, 2018 by its extremely apical position of the cerci (Fig. 3B–D, and figs 5, 6 in Simutnik and Perkovsky 2018a). The genus name is a masculine noun.

Diagnosis. Habitus not 'encyrtiform', body not compact, slightly elongated and flattened; minimum distance between eyes almost 0.5× head width; frontovertex broader than long, ocelli in strongly obtuse triangle, posterior ocelli elliptical in dorsal view; all 6 funicular segments transverse, first funicular segment ring-like; clava only slightly shorter than funicle, about 2.2× as long as broad; mesoscutum and scutellum flat, notaular lines absent; scutellum as long as broad, flat, and as long as mesoscutum; marginal vein more than three times as long as broad, shorter than postmarginal one; covering setae (sensu Sharkov 1985) along basal margin of linea calva present, poorly-developed, but much longer than in *Archaeocercus* (Fig. 3A: cs and fig. 6 in Simutnik and Perkovsky 2018a); filum spinosum absent; parastigma not widened, only slightly wider than previous part of submarginal vein; strigil poorly developed; cerci located extremely close to gastral apex (Fig. 3B–D); apex of hypopygium reaching way past apex of gaster (Fig. 3B–D), lateral margins of hypopygium with row of short setae (Fig. 3C); ovipositor sheaths very small (supposedly, their rudiments are visible in Fig. 3C, D: v3?); protruding part of ovipositor stylet upwardly bent, approximately as long as mesotarsus (Fig. 3B–D). However, the ovipositor, partly, is in the "laying or ovipositing position". Therefore, when it was not in the ovipositing position, it would be mostly retracted and enclosed within the hypopygium and not really truly exserted. The hypopygium may also slightly not reach to the apex of the gaster.

Remarks. The new genus is very similar to *Archaeocercus* Simutnik, 2018, but differs by the OOL being equal to the posterior ocellar diameter, the posterior ocelli are relatively larger and elliptical in dorsal view; the clava is more narrow and elongated;

the parastigma is not expanded (*Archaeocercus* with distinct parastigma, see figs 1, 2, 6 in Simutnik and Perkovsky 2018a); notauli are absent; the scutellum is longer, as broad as long, not shorter than the mesoscutum; the inner angles of the axillae are wider; the covering setae along linea calva are short but distinctly present; and by its long ovipositor stylet (in the "ovipositing position")(see figs 1–6 in Simutnik and Perkovsky 2018a). *Trjapitzion* Simutnik, 2018 clearly differs from the new genus in a high interantennal prominence, strongly expanded parastigma, strongly widened scape and mandible, and in very short legs, especially tarsi (figs 2, 3, 6 in Simutnik and Perkovsky 2018b).

***Archaeocercoides puchkovi* Simutnik, sp. nov.**
http://zoobank.org/50A0A5E5-EFD7-4C7C-AD5B-2B095282C5A9
Figs 1A, B, D, 2, 3

Material. ***Holotype***, SIZK, no. UA-28099, 1♀, Varash District, Rovno Region, Ukraine; Rovno amber; late Eocene. The inclusion is in a yellow and clear piece of amber in a shape of parallelepiped (ca. 40 × 10 × 9 mm), one side of which contains a layer of organic residues. All body parts are preserved.

Syninclusion. Crawler of Coccoidea (Fig. 1C, D).

Etymology. The species is named in memory of our colleague coleopterist Prof. Aleksandr Vasilievich Puchkov.

Description. Female. Habitus as in Figs 1B, 2C. Body not compact, slightly elongated and flattened. Body length 1.2 mm.

Coloration. Body, antenna, tegula, gaster dorsally and ventrally black; surface of frontovertex, mesoscutum, scutellum and axillae smooth, shiny, but without metallic shine, monotonously shallow reticulate with sparse punctures, evenly clothed in short setae (Figs 1B, 2A); coxae, and legs black, meso- and metatibia with lighter apices; protarsus dark; mesotibial spur, meso- and metatarsus light brown to yellowish.

Head. Hypognathous, slightly wider than thorax (8:7) in dorsal view, twice as broad as long, with rounded occipital margin; eyes bare, with inner orbits parallel; minimum distance between eyes almost 0.5× head width; OOL about equal to posterior ocellar diameter (Fig.2A); OCL about equal to half of posterior ocellar diameter; OOL:POL:LOL:OCL about 1:9:5.5:1.5; eye reaching occipital margin; facial cavity and interantennal prominence present but without distinct antennal scrobes (Fig. 2A); toruli located above of mouth margin, about at level of lower margin of eyes (Fig.2B); malar sulcus complete; mandibles, probably two-toothed, with powerful teeth (Fig. 2B).

Antenna. Geniculate, 11-segmented (1:1:6:3); radicle short, about 2–2.5× as long as broad; scape wide, flattened (Fig. 2A); pedicel conical, slightly shorter than F1–F4 combined, longer than any segment of funicle; funicle cylindrical, all segments broader than long, width of flagellomeres increases toward apex; F4–F6 and all segments of clava with mps (Fig. 2A, B); clava large, only slightly shorter than funicle, about 2.2×

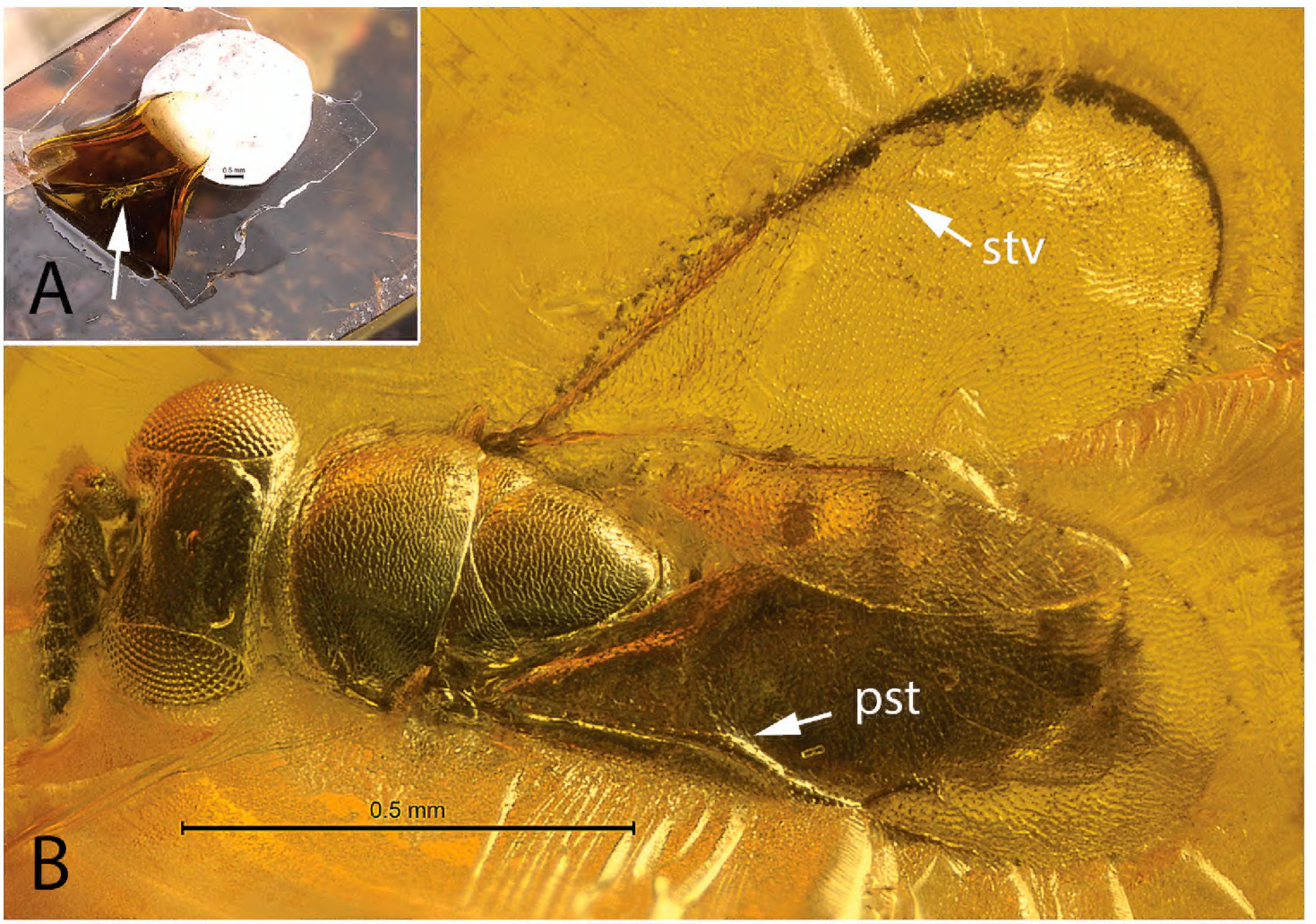

Figure 1. A cover slip at some angle to the surface of the amber, the inclusion is shown by an arrow **B** *Archaeocercoides puchkovi*, gen. et sp. nov., holotype female, body, dorsal (pst – parastigma, stv – stigmal vein) **C** syninclusion, crawler of Coccoidea **D** *A. puchkovi*, gen. et sp. nov., fossilized near the crawler of Coccoidea (arrow). Scale bars: 0.5 mm (**A, B, D**); 0.2 mm (**C**).

as long as broad, with small oblique truncation on non-acute apical segment (Fig. 2B: ot), slightly wider than F6; flagellum and clava clothed in short setae.

Mesosoma. Pronotum short, almost vertical, in dorsal view without transverse dorsal surface (Fig. 2A); mesoscutum broader than long, flat; axillae transverse-triangular with anteromedial angles contiguous (Fig. 2A); prepectus large, bare, polygonally reticulate, posterior margin extended to base of tegula; acropleuron convex, bare, with shallow longitudinal reticulate sculpture, long, in lateral view twice as long as height (Fig. 2C: ac), with distinct acropleural sulcus; subtegular region (Fig. 2D: str) of acropleuron large, convex, delineated by distinct sulcus; metapleuron narrow, without visible setation (Fig. 2C).

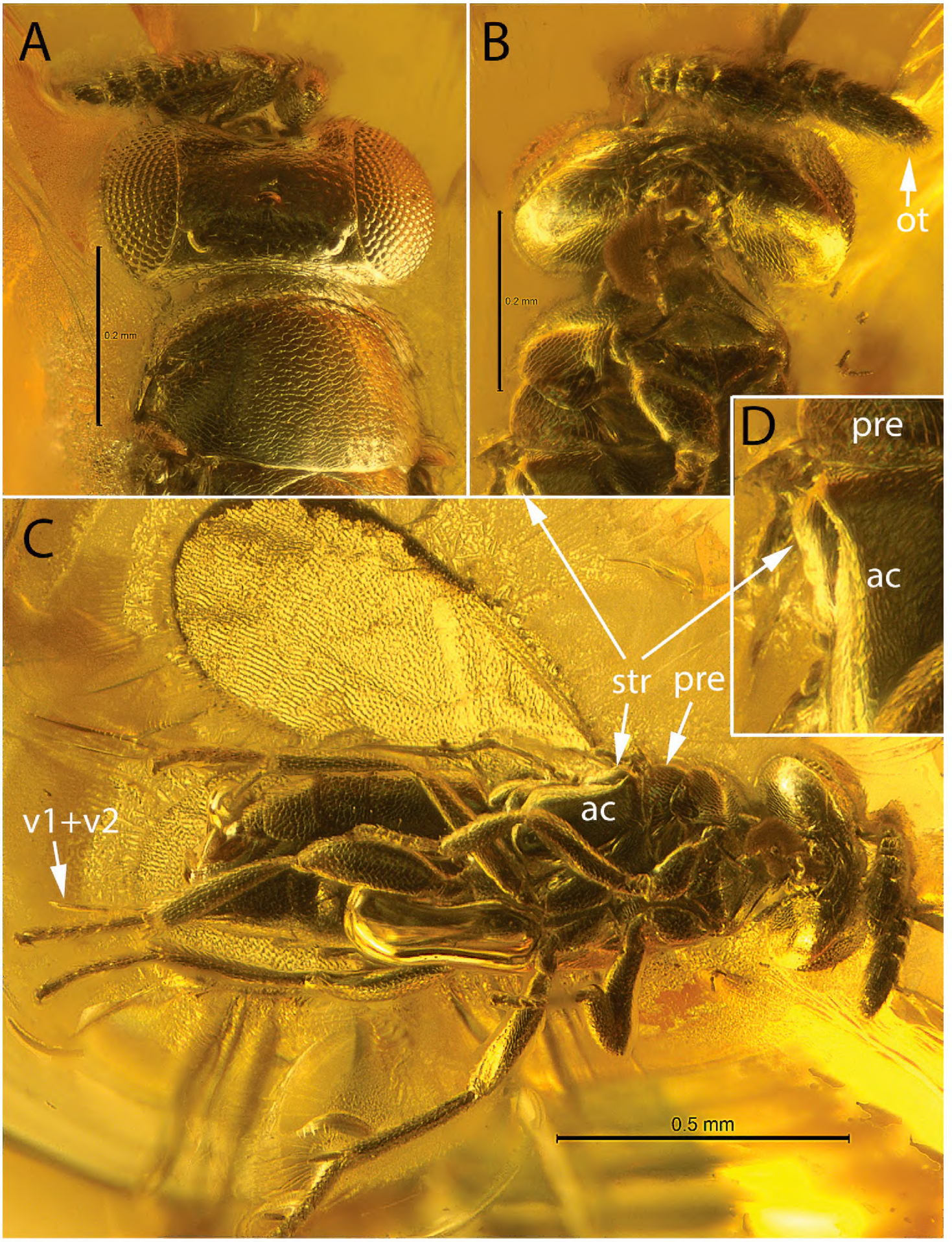

Figure 2. *A. puchkovi*, gen. et sp.nov., holotype female **A** head, mesoscutum, dorsal **B** head, anterior part of the mesosoma, ventral (ot – oblique truncation) **C** body, ventrolateral (ac – acropleuron, pre – prepectus, str – subtegular region, v1 + v2 – ovipositor stylet) **D** subtegular region, ventrolateral. Scale bars: 0.2 mm (**A, B**); 0.5 mm (**C**).

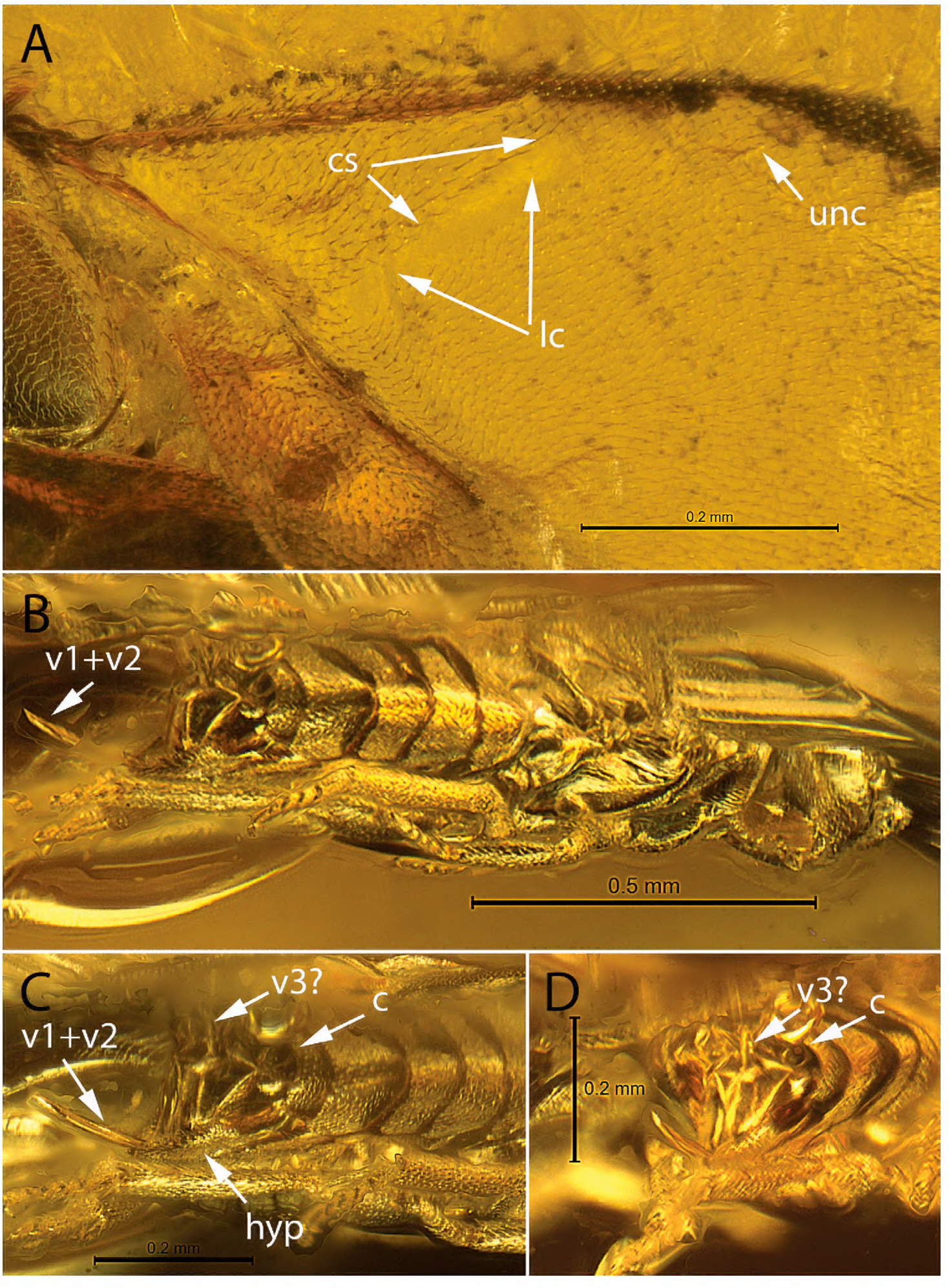

Figure 3. *A. puchkovi*, gen. et sp. nov., holotype female **A** wings (cs – covering setae, lc– linea calva, unc – uncus) **B** body, lateral (v1 + v2 – ovipositor stylet) **C** apex of gaster, lateral (c – cercus, hyp– hypopygium, v3? – supposedly, ovipositor sheath) **D** apex of gaster, posterolateral. Scale bars: 0.2 mm (**A, C, D**); 0.5 mm (**B**).

Wings. Fully developed. Fore wing with basal cell uniformly setose; costal cell narrow; submarginal vein without distinct extension (Fig. 3A), although, when lighting from above, parastigma appears to be somewhat swollen (Fig. 1B: pst); hyaline break (unpigmented area) present; marginal vein long, but slightly shorter than stigmal and postmarginal veins (Fig. 1B, left wing); proportions of forewing venation as in Figs 1B, 2C, 3A; stigmal vein with long narrow uncus, consisting row of uncal sensillae (Fig. 3A: unc); enlarged seta marking apex of postmarginal vein of fore wing rather absent (Fig. 3A); setae of marginal fringe short.

Legs. Normal in size, alike polygonally reticulate; protibia with long, curved calcar; basitarsal comb poorly developed; tarsi 5-segmented; mesotibial spur slightly shorter than mesobasitarsus; metatibia with two spurs.

Gaster. As long as mesosoma, polygonal reticulate equal dorsally and ventrally, apical margins of metasomal terga straight, parallel; paratergites and cercal setae not visible; ovipositor stylet combined from 1st and 2nd valvulae (stylet suture presumably visible in Fig. 3C); hypopygium in Fig. 3B–D: hyp.

Male. Unknown.

Genus *Rovnopositor* Simutnik, gen. nov.

http://zoobank.org/45722928-C925-48E9-930F-D5BD9759E370

Type species. *Rovnopositor voblenkoi* Simutnik, sp. nov.

Species composition. Type species only.

Etymology. The name of the genus is a combination of the words "Rovno" and "ovipositor". The new genus is distinguished by an unusual ovipositor structure. Gender masculine.

Diagnosis. Habitus not 'encyrtiform', body not compact, not flattened; ocelli in almost right angled triangle (Fig. 5B), posterior ocelli elliptical in dorsal view; frontovertex about as long as broad; flagellum long, first funicular segment 1.5× as long as broad, funicle without transverse segments; clava slightly longer than F4–F6 combined, 2.5× as long as broad; mesoscutum and scutellum convex, notauli absent; scutellum as broad as long, and as long as mesoscutum; marginal vein relatively short, twice as long as broad, and one-third as long as postmarginal vein; setae along basal margin of linea calva short; filum spinosum absent; parastigma almost not widened; strigil present, well-developed; cerci slightly advanced toward gastral base, with long cercal setae (Fig. 5D: cers); apex of hypopygium reaching way past apex of gaster (in ovipositing position, Fig. 5A,D: hyp), lateral margins of hypopygium bare, without row of setae; protruding part of ovipositor stylet stout, upwardly bent (in ovipositing position); ovipositor sheaths strongly reduced, not visible in lateral view.

Remarks. The new genus differs from *Archaeocercoides* in the right angled ocellar angle; the frontovertex is about as long as broad; its long flagellum, the first funicular segment being longer than broad, the funicle without transverse segments; the clava slightly longer than F4–F6 combined, 2.5× as long as broad; the relatively short marginal vein, twice as long as broad and one-third length of postmarginal vein; the

convex mesoscutum and scutellum; the well-developed strigil; the cerci are noticeably advanced toward the gastral base; the lateral margins of hypopygium are bare; and in its stouter and longer protruding part of the ovipositor stylet (in ovipositing position).

***Rovnopositor voblenkoi* Simutnik, sp. nov.**
http://zoobank.org/1940BF44-3174-40EE-8DD7-305A9013317C
Figs 4, 5

Material. ***Holotype***, SIZK, no. K-9948, 1 ♀, Klesov, Sarny District, Rovno Region, Ukraine; Rovno amber; late Eocene. The inclusion is in a reddish and not very transparent piece of amber in a shape of irregular triangular prism (ca. 10 × 10 × 15 × 7 mm) (Fig. 4B). All body parts are preserved.

Syninclusions. SIZK, no. K-9949, 2 Dolichopodidae, Aranei, stellate hairs.

Etymology. The species is named in memory of our colleague Aleksandr Sergeevich Voblenko, an entomologist, zoologist, naturalist, and teacher.

Description. Female. Habitus as in Fig. 4C. Body not compact, not flattened. Body length 1.25 mm.

Coloration. Body, antennae, gaster dorsally and ventrally dark, without metallic shine, monotonously shallow reticulate; pronotum, mesoscutum, and scutellum clothed in more long setae.

Head. Hypognathous, wider than its length, slightly wider than thorax, with rounded occipital margin (Fig. 5B); eyes bare, with inner orbits rather slightly divergent (Fig. 4D); OOL equal to posterior ocellar diameter; OCL about twice as long as posterior ocellar diameter; eye reaching occipital margin; interantennal projection small but visible in lateral view (Fig. 4A); toruli located at level of lower margin of eyes (Fig. 4A); malar sulcus complete; height of eye about twice larger than malar space; mandibles narrow, probably two-toothed (Figs 4A, C; 5A).

Antenna. 11-segmented (1:1:6:3); radicle short, twice as long as broad; scape long, about 5× as long as broad (Fig. 4A); pedicel conical, as long as F1 and F2 combined, longer than any segment of funicle; funicle not flattened, width of flagellomeres slightly increases toward apex; all segments of funicle and clava with mps (Fig. 4A); clava with small oblique truncation on rounded apical segment (Fig. 4A), slightly wider than F6; flagellum and clava clothed in short setae.

Mesosoma. Pronotum short, almost vertical, in dorsal view without transverse dorsal surface (Fig. 5B); mesoscutum about as broad as long; axillae transverse-triangular with anteromedial angles contiguous; prepectus large, bare, polygonally reticulate (Fig. 5B); acropleuron convex, bare, with shallow longitudinal reticulate sculpture, long; subtegular region of acropleuron large, convex, delineated by distinct sulcus; metapleuron and propodeum without visible setation (Fig. 4C).

Wings. Fully developed. Fore wing with costal cell narrow; submarginal vein without extension; hyaline break present; setation of linea calva in holotype poorly visible (Fig. 5C); marginal vein 0.5× as long as stigmal one; proportions of forewing venation as in Fig. 5C; stigmal vein with long narrow uncus, consisting row of uncal

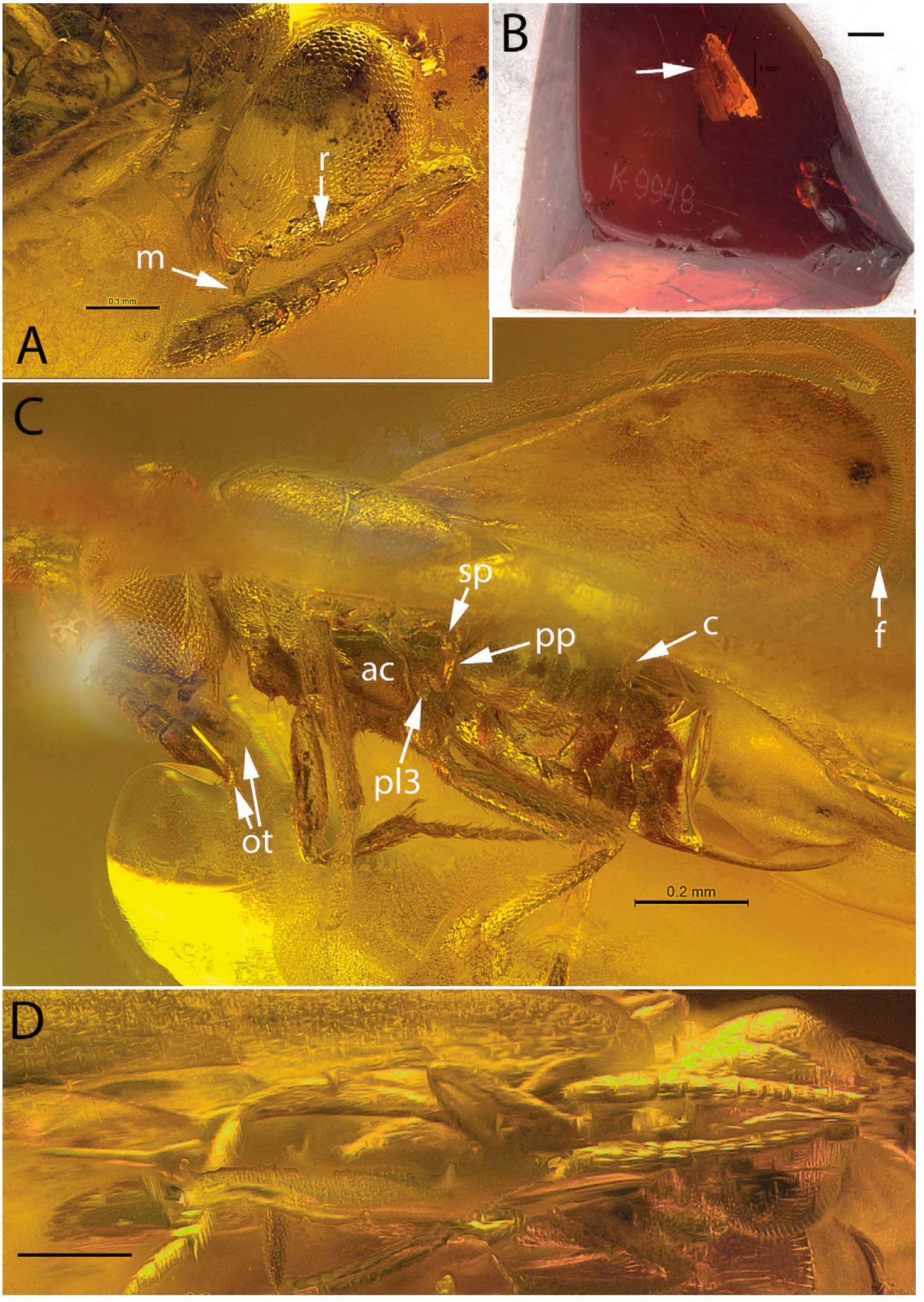

Figure 4. *Rovnopositor voblenkoi* gen. et sp. nov., holotype female **A** head, antenna, lateral (m – mandible, r – radicle) **B** piece of amber with holotype (arrow) **C** body, dorsolateral (ac – acropleuron, c – cercus, f – marginal fringe, ot – oblique truncation, pl3 – metapleuron, pp – prepectus, sp – spiracle) **D** body, ventral. Scale bars: 0.1 mm (**A**); 1 mm (**B**); 0.2 mm (**C, D**).

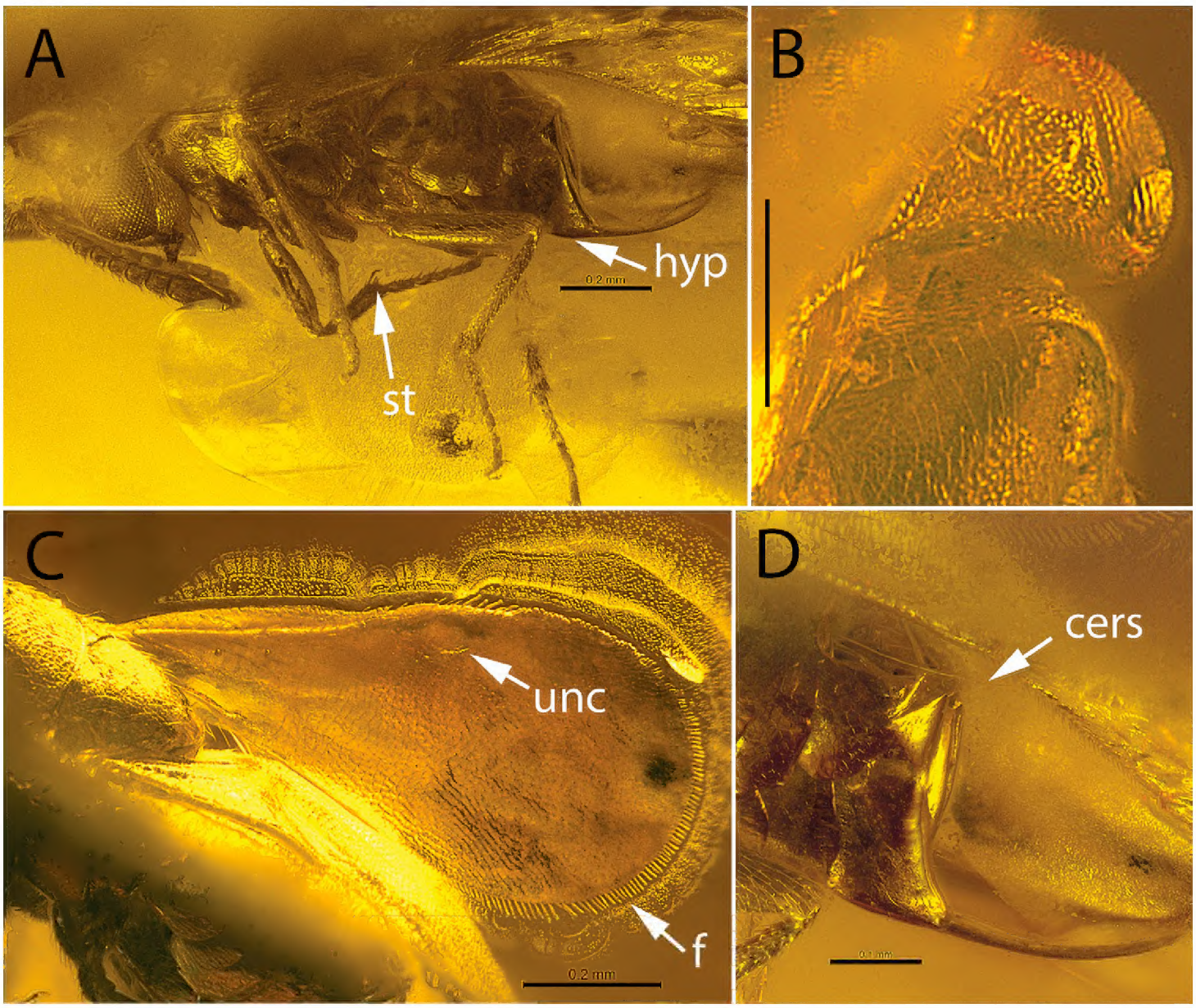

Figure 5. *R. voblenkoi*, gen. et sp. nov., holotype female **A** body, lateral (hyp – hypopygium, st – strigil) **B** head, anterior part of the mesosoma, dorsolateral **C** forewing (f – marginal fringe, unc – uncus) **D** apex of gaster, lateral (cers – cercal setae). Scale bars: 0.2 mm (**A–C**); 0.1 mm (**D**).

sensillae; postmarginal vein with row of long setae; setae of marginal fringe present (Fig. 5C).

Legs. Normal in size, alike polygonal reticulate; protibia with long, curved, bifurcate calcar; strigil well-developed but distinct basitarsal comb absent (Figs 4C, 5A: st); tarsi 5-segmented; mesotibial spur slightly shorter than mesobasitarsus; metatibia with two spurs.

Gaster. As long as mesosoma, polygonal reticulate equal dorsally and ventrally; protruding part of ovipositor stylet approximately as long as metatarsus (in ovipositing position); suture between 1st and 2nd valvulae clearly visible at base and at apex of stylet (Fig. 5D).

Male. Unknown.

Discussion

The new genera differ from most extant members of the family by their short radicle, long veins of the forewing, and by the apical position of the cerci. A more detailed

comparison with extant genera with apical or nearly apical position of the cerci is provided by Simutnik 2021; Simutnik et al. 2021a, 2021b. In particular, extant *Eucoccidophagus* Hoffer, 1963; *Aphycoides* Mercet, 1921; and *Prionomastix* Mayr, 1876 are well distinguished from the all known extinct genera by having a very short marginal vein. *Archaeocercoides*, *Rovnopositor*, and *Archaeocercus* also differ from *Aphycoides* and *Prionomastix* in the absence of a filum spinosum and the shape of Mt8 (fig. 12C in Simutnik 2021 and fig. 9 in Simutnik et al. 2021b).

The venation of the forewings and the very small ovipositor sheaths in the newly described taxa most closely resemble those of *Moraviella* Hoffer, 1954; *Monodiscodes* Hoffer, 1954; *Savzdargia* Trjapitzin, 1979; possible, some species of *Ericydnus* Walker, 1837; and some other extant Tetracneminae. *Savzdargia* may be the "most primitive" extant Tetracnemine (Trjapitzin 1989; Noyes and Hayat 1994; J. S. Noyes pers. comm., 2022). At the same time, the paratergites (the presence of which is one of the main features of Tetracneminae) has not yet been found in fossil encyrtids, including the taxa described here. Tetracneminae is probably a more derived group – it always comes out as a derived group in DNA based phylogenetic analyses (J. S. Noyes pers. comm., 2022). Therefore, it would be premature to classify *Archaeocercus*, *Archaeocercoides*, *Rovnopositor* and other known fossil Encyrtidae without the filum spinosum as members of the Tetracneminae within the current concept of this subfamily. Their taxonomic placement within the family remains uncertain.

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